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1 Scope:

This specification establishes the inspection and quality assurance requirements for 1/4 inch thick yoke laminations intended for use in RHIC 8cm dipole magnets. These laminations shall be fineblanked from extra low carbon magnet steel and shall be assembled into right and left-handed pinned collar modules with 1/2 in. diameter stainless steel shear pins.

2 Applicable Documents:

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issue date or revision level shall be that in effect on the date of the invitation to quote.

2.1 BNL Specifications:

RHIC-MAG-M-4344	1/4 Inch Thick Magnet Steel for RHIC Production Dipole and Quadrupole Yoke Laminations
RHIC-MAG-M-4353	Iron Phosphate Coating for Dipole and Quadrupole Yoke Laminations
BNL-QA-101	BNL Seller Quality Assurance Requirements

2.2 Engineering Drawings:

12010057	Yoke Lamination
12010011	Shear Pin
12010032	Collar Module Middle, R.H. Assembly
12010033	Collar Module Middle, L.H. Assembly
12010034	Collar Module Lead End, R.H. Assembly
12010035	Collar Module Lead End, L.H. Assembly

3 Requirements:

3.1 Process Materials: All steel used in the manufacture of 8cm dipole yoke laminations shall be in accordance with BNL specification RHIC-MAG-M-4344.

3.2 Steel Procurement: It shall be the sole responsibility of the Prime Contractor (PC) to procure the magnet steel and to assure that the steel conforms to all of the requirements set forth in BNL specification RHIC-MAG-M-4344.

- 3.3 Steel Approval: The PC shall manufacture yoke laminations strictly from steel for which he has written approval from Brookhaven National Laboratory (BNL).
- 3.4 Steel Storage: The PC shall be responsible for storage of the steel until its use and shall take all the necessary steps to protect it against oxidation and/or physical damage.
- 3.5 Phosphate Coating: This process shall be performed in accordance with BNL specification RHIC-MAG-M-4353.
- 3.6 Pinning Operation: In addition to performing the blanking operation, the PC shall be responsible for pinning the laminations into right and left-handed pairs (pinned collar modules) with two stainless steel shear pins in accordance with the applicable drawings (P/N's 12010032, 12010033, 12010034, 12010035).
- 3.7 Process Uniformity: Since uniformity of the dimensional and magnetic characteristics of the yoke laminations is fundamentally important to the successful operation of RHIC magnets, there shall be no change in manufacturing methods during the entire production run without prior written approval from BNL.
- 3.8 Prime Contractor's CMM Inspection: The PC is required to use a CMM (coordinate measuring machine) to perform all inspections of yoke laminations and pinned collar modules. The CMM is not required for the shear pin inspection.

4 Quality Assurance Provisions:

4.1 P/N 12010057 (Lamination) - First Article:

- 4.1.1 First Article Inspection: First article approval shall be based on a complete dimensional inspection performed by BNL using a computer controlled CMM, of twenty phosphate coated laminations (not pinned collar modules) in order to assess their conformance with the applicable drawing. The PC is responsible for assuring that the date and a number from "1" through "20" are permanently scribed on the face of each first article lamination and shall refer to these identification numbers when reporting any first article inspection data (as in Sect. 4.1.2). The phosphate coating on these laminations shall be in accordance with BNL specification no. RHIC-MAG-M-4353. The PC shall not begin blanking production laminations without written approval from BNL stating that the twenty sample laminations have passed first article inspection. A first article inspection shall be performed for each fineblanking die or at anytime major rework is performed on the die or press.

4.1.2 Prime Contractor's First Article Inspection Data: The twenty phosphate coated yoke laminations sent to BNL for first article inspection shall also be accompanied by the PC's detailed inspection report. This report shall include the following:

- a. A complete dimensional inspection of each lamination performed by the PC.
- b. A certificate of conformance for the phosphate coating which has been signed by the PC's Q.A. manager. This document shall demonstrate compliance to RHIC-MAG-M-4353.

4.1.2.1 Establishing Critical Datum Planes: Refer to appendix I for axis definitions.

4.1.3 Marking Identification Requirements: The package of first article laminations (and accompanying paperwork) shall be identified with the following data, in the order given.

RHIC-MAG-M-4337 - RHIC 8cm Dipole Yoke	
Laminations * FIRST ARTICLE *	
Purchase Order No. _____.	
Manufacturer's Name _____.	
Part No. (Rev. Status) <u>12010057 Rev ()</u> .	
Quantity <u>20</u>	

4.2 P/N's 12010032, 12010033, 12010034, 12010035, & 12010011 (Pinned Collar Modules, R.H., L.H., & Shear Pin) - First Article:

The PC shall not commence fabrication of first article pinned collar modules without written approval from BNL stating that P/N 12010057 has been approved based on first article inspection (Sect. 4.1).

4.2.1 First Article Inspection: Approval shall be based on a complete dimensional inspection performed by the PC (using a computer controlled CMM that generates a print-out) of:

- a. 8 Pinned Middle Collar Modules (R.H.), P/N 12010032
- b. 8 Pinned Middle Collar Modules (L.H.), P/N 12010033
- c. 2 Pinned Lead End Collar Modules (R.H.), P/N 12010034

d. 2 Pinned Lead End Collar Modules (L.H.), P/N 12010035

e. 10 Shear Pins, P/N 12010011 (CMM not required).

The PC shall permanently scribe the date and a number from "1" through "8" on the face of each P/N 12010032, a number from "9" through "16" on the face of each P/N 12010033, the numbers "17" and "18" on the face of each P/N 12010034, and the numbers "19" and "20" on the face of each P/N 12010035. The PC shall refer to these identification numbers when recording inspection data (as in Sect. 4.2.2). The ten sample shear pins shall be bagged and tagged as "P/N 12010011 - First Article," and packaged along with the first article pinned collar modules. A first article inspection shall be performed for each separate pinning fixture.

4.2.2 Prime Contractor's First Article Inspection Data: The twenty pinned collar modules sent to BNL for first article inspection (as per Sect. 4.2.1) shall also be accompanied by the PC's own detailed inspection report. Included in this report shall be the following:

- a. A complete dimensional inspection of each pinned collar module performed by the PC.
- b. A material certification report for the shear pins. This report shall pertain to the full production order.

4.2.2.1 Establishing Critical Datum Planes: Refer to Appendix I.

4.2.3 Marking Identification Requirements: The package of first article pinned collar modules (including the sample shear pins and all accompanying paperwork as per Sect. 4.2.2) shall be identified with the following data, in the order given:

RHIC-MAG-M-4337 - RHIC 8cm Dipole Pinned Collar Modules (FIRST ARTICLE)
Purchase Order No. _____.
Manufacturer's Name _____.
Part No(s)/(Rev.) <u>12010032, 12010033,</u>
<u>12010034, 12010035,</u>
<u>12010011</u>
Qty. <u>20 Pinned Collar Modules/10 Shear Pins</u>

4.3 P/N's 12010032, 12010033, 12010034, & 12010035 (Pinned Collar Modules, R.H.& L.H.) - Production Articles:

The PC shall not commence fabrication of production pinned collar modules without written approval from BNL stating that the first article pinned collar modules and shear pins have been approved based on first article inspection (Sect. 4.2).

4.3.1 On-Line Dimensional Quality Control:

The PC shall maintain continuous strict quality control during all phases of production. This level of quality control shall consist of the following procedures.

4.3.1.1 Statistical Process Control (SPC): The PC shall monitor all aspects of the production process (blanking, phosphate coating, and pinning) on a continual basis using up-to-date methods of SPC. Histograms, quality control charts, and trend plots shall be retained by the PC and made available to BNL upon request.

4.3.2 Division into Lamination Production Lots: The PC shall divide all laminations into a series of production lots, each of which shall be denoted by a lot ID number. The production lot number shall be updated after any process or tooling alteration has occurred (other than routine die maintenance) or after 25,000 consecutive laminations have been blanked, whichever occurs first. The PC shall have on record the reason for all production lot updates and shall inform BNL any time such an update occurs. Each lamination shall be metal stamped with the lot ID number in the location indicated on the drawing.

4.3.3 Certificate of Conformance for the Phosphate Coating (Production Articles): Each production lot of pinned collar modules shall be accompanied by a certificate of conformance for the phosphate coating. This document shall demonstrate compliance to RHIC-MAG-M-4353 and shall be signed by the PC's Q.A. manager.

4.4 Other Quality Assurance Provisions:

4.4.1 Non-Conforming Articles: Laminations or pinned collar modules which do not fully meet the requirements of the purchase order shall not be offered to BNL. In the event that such articles are shipped, the PC shall bear all additional costs this might incur.

4.4.2 Applicable BNL-QA-101 Paragraphs: 3.1.2, 4.5, 4.10, 4.10.1, 4.11, 4.16, 4.23

5 Preparation for Delivery:

- 5.1 Cleanliness: Pinned collar modules must be completely dry and shall be free of dirt, oil, grease, metal chips, and other foreign matter and shall show no visible signs of corrosion. This applies to the interior surfaces of the pinned collar modules as well.
- 5.2 Packaging: Pinned collar modules shall be packaged in crates of wood construction. All items in a single crate shall have the same part number as well as the same lot number. They shall be stacked neatly against each other with a sheet of rust inhibiting VCI paper between each of them. Other than the VCI paper, no other rust inhibiting agents shall be employed. Adequate nesting of the pinned collar modules is essential to prevent damage during transport and handling.
- 5.3 Pallet Weight: The crates shall be stacked on top of each other and secured with steel bands to a four-way entry pallet. The gross weight of each pallet shall not exceed 3000 lb.
- 5.4 Marking Identification Requirements: Each individual crate of production articles shall be identified with the following data, in the order given.

RHIC-MAG-M-4337 - RHIC 8cm Dipole Pinned Collar
pole Pinned Collar Modules
Purchase Order No. _____.
Manufacturer's Name _____.
Left/Right Hand _____.
Part No. (Rev. Status) _____.
Lot ID Number _____.
Quantity _____.

APPENDIX I

DEFINITION OF CRITICAL DATUM PLANES

- AI.1 Establishing the Horizontal Axis: In the Prime Contractor's dimensional inspection report, all applicable location measurements shall be based on the assumption that the horizontal datum (also referred to as the X-axis) is a straight line that contacts the two .300 inch wide inner midplane surfaces located at the three and nine O'clock positions of the inside diameter (See figure 1).
- AI.2 Establishing the Vertical Axis: In the PC's dimensional inspection report, all applicable location measurements shall be based on the assumption that the vertical datum (also referred to as the Y-axis) is a straight line which is both:
- a. perpendicular to the horizontal axis, and
 - b. passes through the measured center of the inside diameter. This center shall be determined for each individual lamination and must be based on actual measurements of the inside diameter (See figure 1).

